voľba šéfa: jednosmerné kruhy

Chang Roberts

const: ID : integer
l_{in}, l_{out} : link
var: $leader$: integer

Init:

$leader := NULL$

Code:

send $\langle ID \rangle$
wait until $leader <> NULL$

On receipt $\langle i \rangle$:

if $i < ID$ **then send** $\langle i \rangle$
if $i = ID$ **then**
  $leader := ID$
  send $\langle$**leader**, $ID\rangle$

On receipt $\langle$**leader**, $x\rangle$:

$leader := x$
send $\langle$**leader**, $ID\rangle$

$O(n \log n)$ správ v priemernom prípade, $\Omega(n^2)$ v najhoršom

dvojsmerné kruhy

Hirschberg-Sinclair

- level l: dobýjať územie 2^l
- log n levelov
- $n/2^l$ vrcholov na leveli
- každý vrchol pošle 2^l správ

Franklin

- level l: poraziť susedov (na rovnakom leveli; “synchronizácia”)
- log n levelov
- n správ na level

Dolev – simulácia na 1-smernom kruhu

- idea: presunúť identitu

dolný odhad

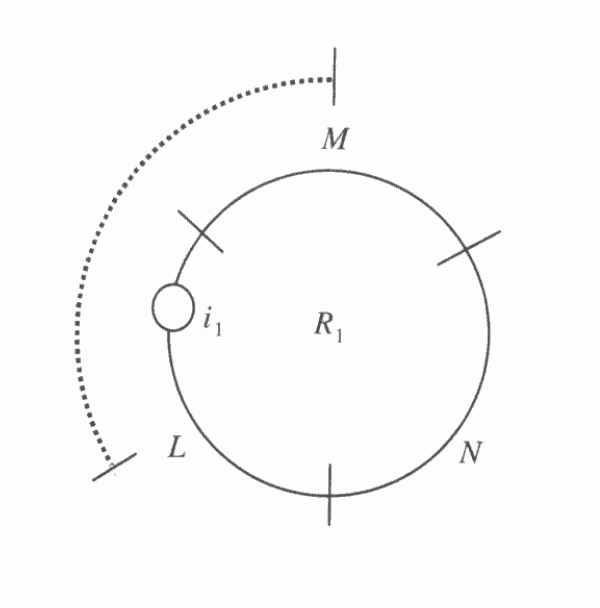
zapojiť do čiary L, vymení sa $C(L)$ správ

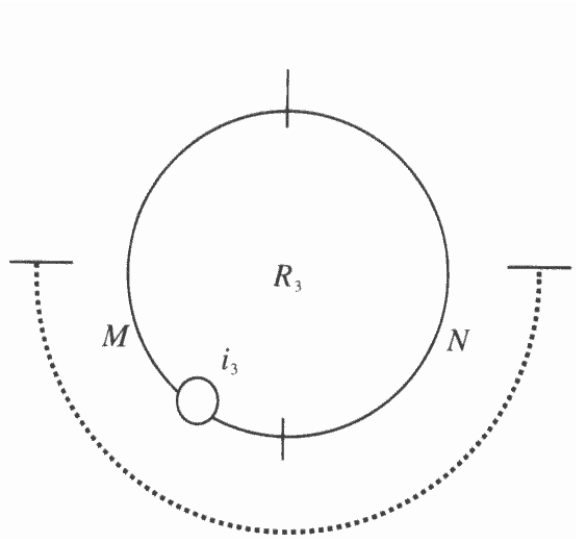
lema

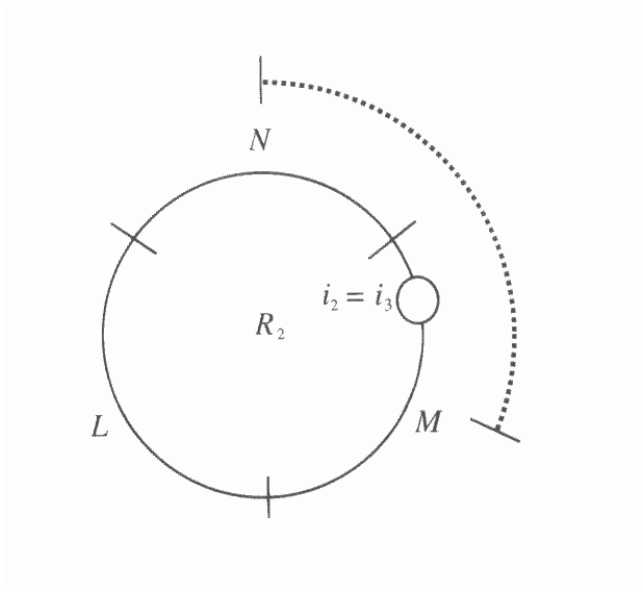
Pre každé r existuje nekonečne veľa čiar dĺžky 2^r, kde $C(L) \geq r2^{r-2}$

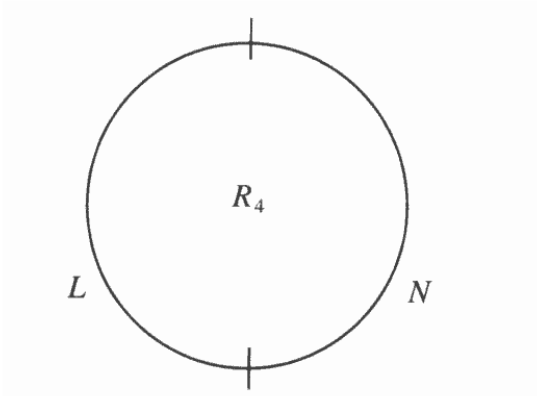
- indukcia
- dve vrecia: vyberám trojice, chcem dve spojiť item pri spojení: dĺžka 2^{r+1}, počet správ $\geq r2^{r-1}$
- ešte treba 2^{r-1} správ; sporom

dolný odhad









GHS

- ľubovoľná topológia
- buduje sa kostra
- “segmenty”
- spájanie po najlacnejšej odchádzajúcej hrane:
  A menší sa pripojí k väčšiemu
  B rovnakí sa spoja
  C väčší čaká
- veľkosť $\Rightarrow$ level

GHS

var $state_p$: $(sleep, find, found)$;
$stach_p[q]$: $(basic, branch, reject)$ for each $q \in Neigh_p$;
$name_p$, $bestwt_p$: real ;
$level_p$: integer ;
$testch_p$, $bestch_p$, $father_p$: $Neigh_p$;
rec_p : integer ;

(1) As the first action of each process, the algorithm must be initialized:
begin let pq be the channel of p with smallest weight ;
$stach_p[q] := branch$; $level_p := 0$;
$state_p := found$; $rec_p := 0$;
send $\langle$ **connect**, 0 $\rangle$ to q
end

(2) Upon receipt of $\langle$ **connect**, L $\rangle$ from q:
begin if $L < level_p$ **then** (* Combine with Rule A *)
begin $stach_p[q] := branch$;
send $\langle$ **initiate**, $level_p, name_p, state_p$ $\rangle$ to q
end
else if $stach_p[q] = basic$
then (* Rule C *) process the message later
else (* Rule B *) send $\langle$ **initiate**, $level_p + 1, \omega(pq), find$ $\rangle$ to q
end

(3) Upon receipt of $\langle$ **initiate**, L, F, S $\rangle$ from q:
begin $level_p := L$; $name_p := F$; $state_p := S$; $father_p := q$;
$bestch_p := udef$; $bestwt_p := \infty$;
forall $r \in Neigh_p : stach_p[r] = branch \wedge r \neq q$ **do**
send $\langle$ **initiate**, L, F, S $\rangle$ to r ;
if $state_p = find$ **then begin** $rec_p := 0$; $test$ **end**
end

GHS

(4) **procedure** *test*:
begin if $\exists q \in Neigh_p : stach_p[q] = basic$ **then**
begin $testch_p := q$ with $stach_p[q] = basic$ and $\omega(pq)$ minimal ;
send $\langle$ **test**, $level_p$, $name_p$ $\rangle$ to $testch_p$
end
else begin $testch_p := udef$; *report* **end**
end

(5) Upon receipt of $\langle$ **test**, L, F $\rangle$ from q:
begin if $L > level_p$ **then** (* Answer must wait! *)
process the message later
else if $F = name_p$ **then** (* internal edge *)
begin if $stach_p[q] = basic$ **then** $stach_p[q] := reject$;
if $q \neq testch_p$
then send $\langle$ **reject** $\rangle$ to q
else *test*
end
else send $\langle$ **accept** $\rangle$ to q
end

(6) Upon receipt of $\langle$ **accept** $\rangle$ from q:
begin $testch_p := udef$;
if $\omega(pq) < bestwt_p$
then begin $bestwt_p := \omega(pq)$; $bestch_p := q$ **end** ;
report
end

(7) Upon receipt of $\langle$ **reject** $\rangle$ from q:
begin if $stach_p[q] = basic$ **then** $stach_p[q] := reject$;
test
end

GHS

(8) **procedure** *report*:
begin if $rec_p = \#\{q : stach_p[q] = branch \wedge q \neq father_p\}$
and $testch_p = udef$ **then**
begin $state_p := found$; send $\langle$ **report**, $bestwt_p \rangle$ to $father_p$ **end**
end

(9) Upon receipt of $\langle$ **report**, $\omega \rangle$ from q:
begin if $q \neq father_p$
then (* reply for **initiate** message *)
begin if $\omega < bestwt_p$ **then**
begin $bestwt_p := \omega$; $bestch_p := q$ **end** ;
$rec_p := rec_p + 1$; *report*
end
else (* pq is the core edge *)
if $state_p = find$
then process this message later
else if $\omega > bestwt_p$
then *changeroot*
else if $\omega = bestwt_p = \infty$ **then stop**
end

(10) **procedure** *changeroot*:
begin if $stach_p[bestch_p] = branch$
then send $\langle$ **changeroot** $\rangle$ to $bestch_p$
else begin send $\langle$ **connect**, $level_p \rangle$ to $bestch_p$;
$stach_p[bestch_p] := branch$
end
end

(11) Upon receipt of $\langle$ **changeroot** $\rangle$:
begin *changeroot* **end**

analýza

správnosť

ukázať, že sa zvolí práve jeden šéf: nenastane deadlock

počet správ

- testovacie správy: jeden test po každej hrane
- kostrové správy: fragment s n_i vrcholmi pri postupe o level $O(n_i)$ správ
- postupy na level l: dizjunktné vrcholy

KKM

- $f(x)$-traverzovanie
- tokeny traverzujú/označujú územia
- levely: keď sa stretnú dva, vznikne nový
- naháňanie

```
var lev_p            : integer     init −1 ;
    cat_p, wait_p    : P           init udef ;
    last_p           : Neigh_p     init udef ;

begin if p is initiator then
        begin lev_p := lev_p + 1 ; last_p := trav(p, lev_p) ;
              cat_p := p ; send ⟨ annex, p, lev_p ⟩ to last_p
        end ;
      while ... (* Termination condition, see text *) do
       begin receive token (q, l) ;
             if token is annexing then t := A else t := C ;
             if l > lev_p then (* Case I *)
               begin lev_p := l ; cat_p := q ;
                     wait_p := udef ; last_p := trav(q, l) ;
                     send ⟨ annex, q, l ⟩ to last_p
               end
             else if l = lev_p and wait_p ≠ udef then (* Case II *)
               begin wait_p := udef ; lev_p := lev_p + 1 ;
                     last_p := trav(p, lev_p) ; cat_p := p ;
                     send ⟨ annex, p, lev_p ⟩ to last_p
               end
             else if l = lev_p and last_p = udef then (* Case III *)
               wait_p := q
             else if l = lev_p and t = A and q = cat_p then (* Case IV *)
               begin last_p := trav(q, l) ;
                     if last_p = decide
                       then p announces itself leader
                       else send ⟨ annex, q, l ⟩ to last_p
               end
             else if l = lev_p and ((t = A and
                  q > cat_p) or t = C) then (* Case V *)
               begin send ⟨ chase, q, l ⟩ to last_p ; last_p := udef end
             else if l = lev_p then (* Case VI *)
               wait_p := q
       end
end
```

počet správ

- naháňacie: 1 na vrchol a level, spolu n za level
- objavovacie: $\sum_i f(n_i)$
- ak f je konvexná, t.j. $f(a) + f(b) \leq f(a+b)$, tak je $O(\log n(n + f(n)))$ správ